Lincoln, Nebraska, like every other city in the United States, has the continuing responsibility to treat residential and industrial wastewater. Wastewater treatment is an expensive process which often gets overlooked by residents. As long as water goes down the drain without a problem, the average person doesn't worry too much about what happens to the water and whatever else gets sent down the drain. That's good - because that means there are no problems with the sanitary sewer system. Behind the scenes however, there are over 100 employees that work for the Lincoln Wastewater System. They are constantly testing, maintaining and improving Lincoln's wastewater treatment facilities.

LAND APPLICATION

Following digestion and dewatering (at Theresa Street), the treated solids are suitable for agricultural land application as a soil amendment and fertilizer. From the Theresa Street treatment plant the digested solids are hauled to local farmers who apply the material with their spreading equipment.

At the Northeast treatment facility the digested sludge, which is in liquid form, is injected beneath the ground surface on agricultural land owned and farmed by the City of Lincoln. Crops grown on this site, located near I-80 and north 70th street, are sold and the revenue is used to offset the costs of wastewater treatment.

The City of Lincoln is working with the University of Nebraska Cooperative Extension of Lancaster County to promote our Biosolids Program to local farming interests. Test plots and on-going crop research using the digested sludge has been helpful in demonstrating the beneficial uses of biosolid materials on cropland.

INDUSTRIAL PRETREATMENT PROGRAM

The City of Lincoln has many industries that use significant amounts of water to produce their goods. Wastewater generated by these industries often contains excessive amounts of pollutants that can overload the treatment processes and be detrimental to the wastewater treatment plants. The Industrial Pretreatment Programs' mission is to regulate pretreatment standards that are established by the Environmental Protection Agency and the City of Lincoln's own sewer use ordinance. City staff routinely sample discharges from 33 major industries to confirm compliance with the pretreatment standards and their individual discharge permit. City staff also assist local industries in determining which technologies are applicable in meeting the pretreatment standards.

These major industries are billed for wastewater treatment services based upon their waste load and strength. Effective pretreatment of wastewater can provide significant savings for the industry.

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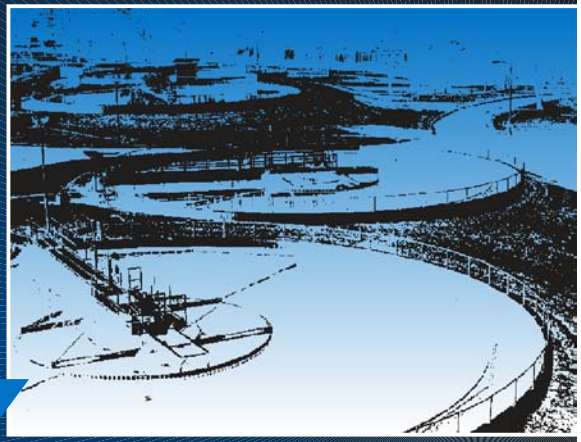


Lincoln, Nebraska's WASTEWATER TREATMENT FACILITIES

Lincoln, Nebraska's WASTEWATER TREATMENT FACILITIES

THERESA STREET FACILITY

Underneath and throughout Lincoln are 840 miles of sanitary sewer lines and 14 pumping stations that keep the wastewater flowing to two municipal treatment plants. The Theresa Street Plant sits on 51 acres along Salt Creek in the north central section of the City. As Lincoln expanded to the east, the Northeast Wastewater Treatment Plant was constructed just south of Interstate 80 and east of Highway 77. The Theresa Street facility has a maximum capacity of 24.5 million gallons per day and on an average day presently treats about 18 million gallons of wastewater. The Northeast facility presently treats about 6.5 million gallons per day. That adds up to 24.5 million gallons of water per day running through the two treatment plants - enough to fill Holmes Lake in 3 and one-half days.

WASTEWATER TREATMENT

Wastewater treatment in Lincoln, Nebraska can be categorized into 8 components. Each component contributes to the overall treatment and final quality of the treated wastewater before it is discharged to Salt Creek. These components are:

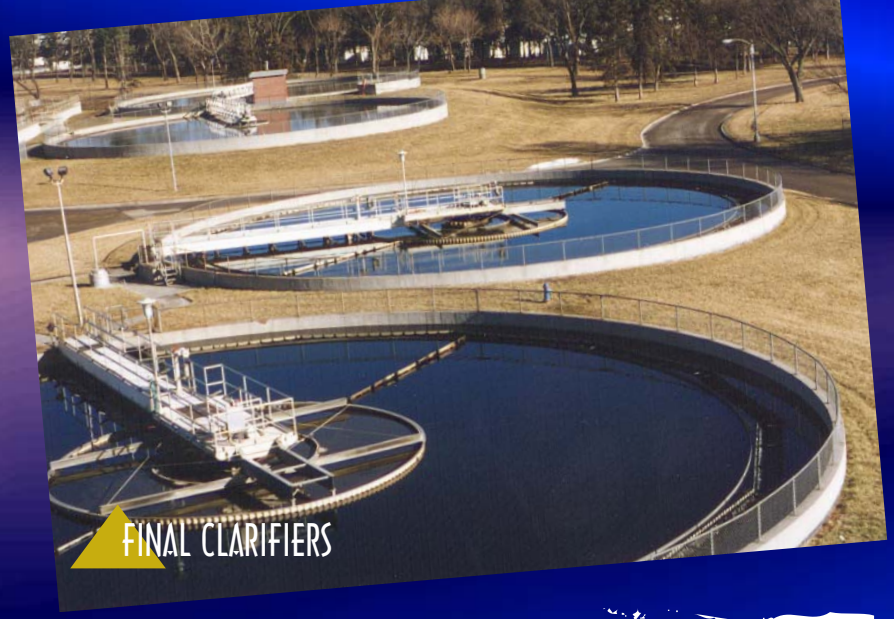
1. Screening, Pumping, and Grit Removal
2. Primary Clarification
3. Biological Treatment
4. Secondary Clarification
5. Disinfection
6. Solids Digestion
7. Solids Dewatering
8. Land Application

SCREENING, PUMPING, & GRIT REMOVAL

Raw sewage enters the treatment plant through two influent pumping stations. At this pumping station large screens with vertically placed bars remove large debris like rags, sticks, and paper. After being screened, the wastewater is pumped to a parallel bank of grit basin tanks. Grit basins are designed to aerate *(add oxygen)* the wastewater and remove heavy particles, like sand, gravel, and egg shells. Material collected from the bar screens and grit basins are hauled to the sanitary landfill.

FIG. 2 AERATED GRID BASIN

Lincoln, Nebraska's WASTEWATER TREATMENT FACILITIES



FINAL CLARIFIERS

After passing through the grit basins, the wastewater enters the primary clarifiers. Primary clarifiers are designed to remove settleable solids which tend to be more organic in nature and settle at a much slower rate. In addition, primary clarifiers have skimmer arms which collect floating materials, like grease. It takes approximately 2 to 4 hours for wastewater to travel through the primary clarifiers.

AERATION BASIN

Once the settleable solids have been removed, the wastewater enters a biological reactor or aeration basin, which is called the biological treatment phase. This treatment phase removes dissolved pollutants within the wastewater, utilizing a diverse population of microorganisms like bacteria, protozoa, stalked ciliates, and rotifers that live within these biological reactors. In order for these organisms to live and reproduce, they must have adequate oxygen and an adequate food supply. These small organisms, which can only be seen through a microscope, use the wastewater as their food source. They feed on the organic matter found in wastewater. There are numerous methods of aerating wastewater for the organisms use. Treatment plants use blowers and submerged diffusers, surface mixers, or cascade the wastewater over rock, plastic or wood media. The by-product of their metabolism is carbon dioxide and water, which leads to a purified and treated effluent. To optimize the metabolism of these microorganisms in treating wastewater, the aeration basins must have adequate oxygen and mixing so that these organisms are in constant contact with their organic food source. Wastewater is typically held within the biological reactors for 4 - 8 hours.

SECONDARY CLARIFICATION

After wastewater leaves the biological reactors, it is sent to the secondary clarifiers. Secondary clarifiers look just like primary clarifiers but serve a different purpose. Due to the feeding requirements of the microorganisms, the wastewater now has a much smaller fraction of organic waste but a significant volume of the wastewater now contains the suspended microorganisms themselves. This combination of treated wastewater and suspended microorganisms is called A “mixed liquor”. Once the mixed liquor reaches the secondary clarifiers, the microorganisms settle to the bottom of the tank. The secondary clarifier is designed to separate the treated wastewater from the microorganism population and return *most* of the microorganisms back to the biological reactor.

Since microorganisms feed and reproduce within the biological reactors, some of the microorganisms must be periodically removed from the treatment system to maintain a relatively steady population. This will be discussed further when solids treatment is reviewed.

DISINFECTION

After the treated wastewater leaves the secondary clarifiers, there is one final treatment step that must be performed before the water can enter Salt Creek. It is called disinfection. Some viruses and bacteria can pass through the treatment process and are not removed. To prevent these organisms from harming human beings, they must be killed. In the disinfection process chlorine is injected and mixed with the wastewater before it enters Salt Creek. With 30 - 60 minutes of mixing and contact time, the chlorine oxidizes and kills these potentially harmful organisms. There is just enough chlorine added to accomplish disinfection and not be harmful to the receiving stream.

BELT FILTER PRESS

ANAEROBIC DIGESTERS

ENGINATORS UTILIZE METHANE GAS

SOLIDS DIGESTION

Organic solids collected from the primary clarifiers and waste solids from the secondary clarifiers are pumped to large tanks called anaerobic digesters where microorganisms break down the solids into a more stable form. The anaerobic digestion process is used at both treatment facilities to stabilize organic solids. Another by-product of the digestion process is the production of methane gas. At the Theresa Street facility this gas is used by two enginators as fuel to generate electrical power and provide heat for the digestion process. The enginators can produce as much as 900 kilowatts of power while maintaining a temperature of 98 degrees Fahrenheit in the three egg-shaped digesters. This benefits the environment by reducing the need for electricity produced from fossil fuels and utilizes the methane gas which would otherwise be wasted.

SOLIDS DEWATERING

Following 18-20 days of digestion, the treated solids are suitable for dewatering and eventual agricultural land application as a soil amendment and fertilizer. Dewatering is a process that removes excess water and reduces the total volume of biosolid waste that must be transported to the land application area. Digested solids from the anaerobic digesters are fed to three belt filter presses which squeeze out excess water between a series of porous belts at the Theresa Street Facility. Once the excess water has been removed, the biosolid a “cake” is loaded into large trucks which haul the dewatered solids to local farm ground in Lancaster County for land application.

Solids dewatering is not used at the Northeast Wastewater Treatment facility.